

REMARKS

Claims 1-18 were rejected under § 103 over *Yunogami et al '081* and *Wong et al '670*. This rejection is respectfully traversed.

Claim 1 as amended recites a resist material having a glass transition temperature that increases under irradiation by an energy beam. After the resist has been exposed and developed to form a pattern, the surface of the resist pattern is then exposed to an energy beam to increase the glass transition temperature in the upper part of the resist pattern. The resist pattern is then baked at a temperature that is in between the glass transition temperature of its upper part and the glass transition temperature of its lower part; this causes the lower part to flow viscously while the upper part does not flow, so that the pattern assumes a tapered shape.

Yunogami teaches irradiating a resist pattern with ultraviolet to harden the resist, then baking the resist to give it a tapered shape; but to judge from Fig. 8 of *Yunogami*, the tapered shape is produced by shrinkage of the resist, not by flow. The word “flow” does not appear in *Yunogami*; only the word “reflow” is found, at line 1 in column 17, referring to a borophosphosilicate glass (BPSG) film, which is not a resist pattern.

The Examiner admits that *Yunogami* is silent with respect to the glass transition temperature, and relies on *Wong* for this feature.

Wong is concerned with shrinkage, like *Yunogami*. *Wong* discloses electron-beam irradiation of just an upper part of a resist layer, but *Wong* discloses this only for controlling shrinkage (e.g., column 2, lines 55-58 or column 11, lines 2-6).

The word “flow” does not appear anywhere in the *Wong* disclosure. *Wong* follows irradiation of the upper part of the resist with etching (e.g., column 3, lines 34-42).

The Examiner asserts that *Wong* discloses that the glass transition temperature indicates flow stability of the resist at col. 10, lines 60-67, reading, in part, “Thermal stability can be measured by glass transition temperature Tg or the flow stability of the patterned resist,” which is merely a definition of the phrase “thermal stability.” The preceding portion of the applied text advertises what *Wong* thinks is a beneficial side effect: it states that irradiation of the upper part of the resist “allows a reduction in the total dose *necessary to achieve* a given level of thermal stability” (emphasis added).

The Examiner is invited to consider that, by saying this, *Wong* teaches against dosages that permit thermal instability—i.e., against the Applicant’s invention, which employs a controlled lack of thermal stability.

Neither this passage, nor the other parts of *Wong* cited by the Examiner, says anything about “baking the resist pattern at a temperature higher than the glass transition temperature of lower parts of the resist pattern but lower than the glass transition temperature of the upper parts of the resist pattern,” as claim 1 recites. *Wong* clearly intends that heat generated during etching or other processing should not cause any change in the shape of the resist.

Claim 10 recites “baking the resist pattern after irradiation by the energy beam, causing lower parts of the resist pattern to flow viscously so that the resist pattern assumes a tapered cross section,” which is also not disclosed or suggested by either reference.

Furthermore, neither *Yunogami* nor *Wong* says anything about creating a tapered cross section by causing the lower parts of a resist pattern to flow outward, instead of causing the upper parts of the resist to shrink inward. The Examiner is invited to note that the shrinkage techniques taught by *Yunogami* and *Wong* could not be used to form a tapered resist pattern with a reduced

lower diameter, such as the Applicant achieves. Instead, these prior-art techniques produce a tapered resist pattern with an enlarged upper diameter, which is not as fine a feature.

In addition, neither *Yunogami* nor *Wong* says anything about forming a tapered feature in the substrate by etching the substrate by a process that simultaneously etches the tapered cross section of the resist pattern, as is recited in claim 10.

For example, the generally tapered contact hole 20 shown in Fig. 23 in *Yunogami* et al. is due to the tapered shape of silicon nitride sidewall spacers 18 created by anisotropic etching (Fig. 22), not by the tapered shape of a resist pattern created by the technique of the present invention.

The Applicant sees no motivation, in the references themselves, toward combination. With respect, the motivation asserted by the Examiner (to affect the lateral and vertical profile of the resist by flow) is taken from the Applicant, not from the prior art.

Withdrawal of the rejection is requested.

Respectfully submitted,



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Date

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